

Comparison of Ensemble Total Inward Leakage Tests

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Objectives

- Determine the relationship between the three most commonly used total inward leakage (TIL) tests for personal protective equipment (PPE) ensembles
- Evaluate the Inward Leakage Test (ILT), Man-In-Simulant Test (MIST, Fig 1), and modified Laboratory Respirator Protection Level (LRPL, Fig 2) and compare protection factor ranges
- Provide information to standards development organizations (SDOs) to assist in method selection and determination of pass/fail criteria

Background

- Performance requirements in several current PPE standards require ensembles to be tested using a full body integrity or TIL test
- Three ensemble TIL tests are commonly used, but no research has been conducted to compare and contrast the methods and thus appropriate application of the methods is not well understood
- The SDOs have struggled to select the ensemble TIL method that most accurately and effectively challenges PPE designed for use in certain hazard situations

Stakeholders

- Firefighters / emergency responders
- Standards organizations (NFPA, ASTM, ISO)
- Ensemble manufacturers
- Test laboratories / certification organizations

Partnerships

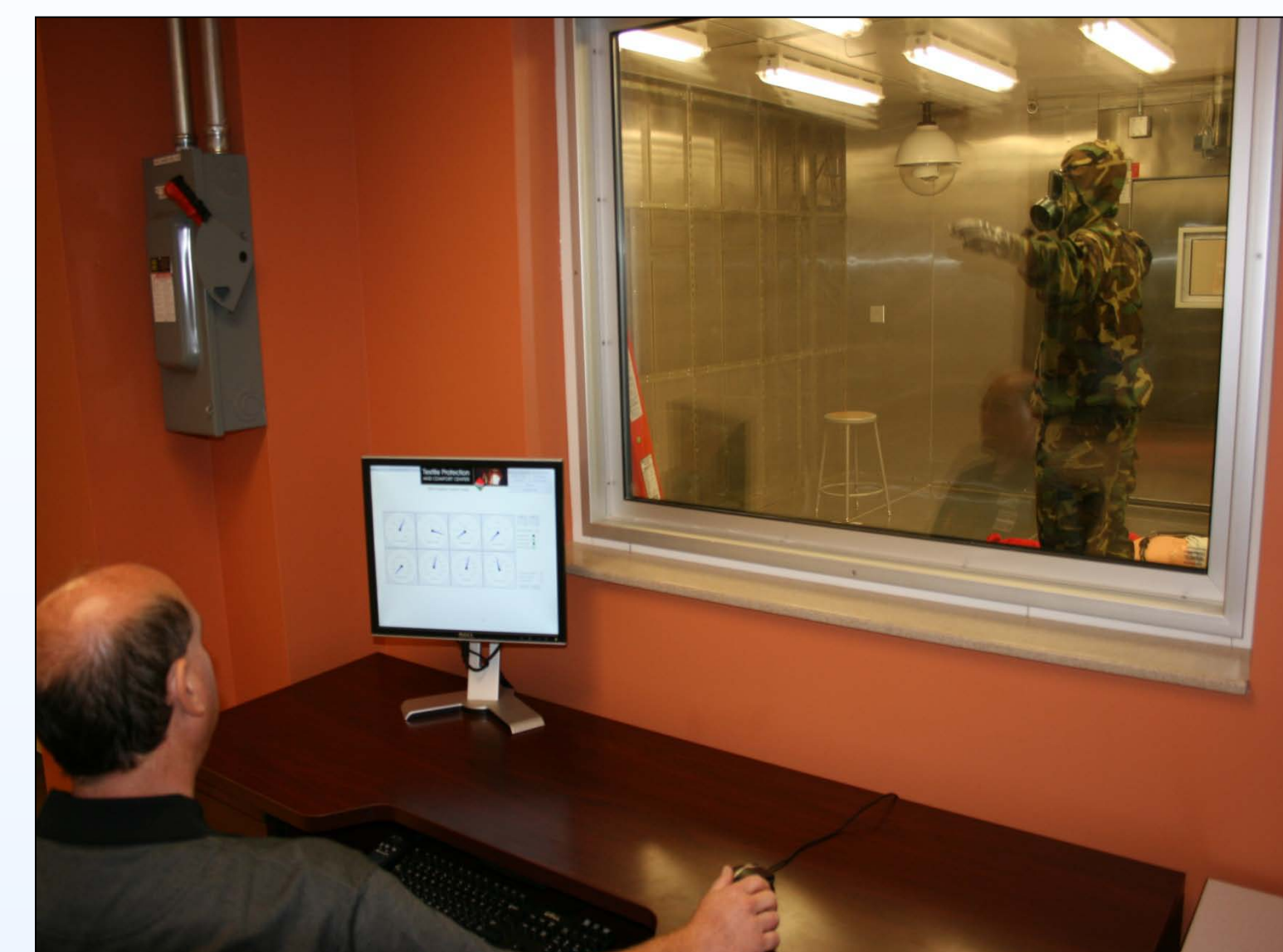
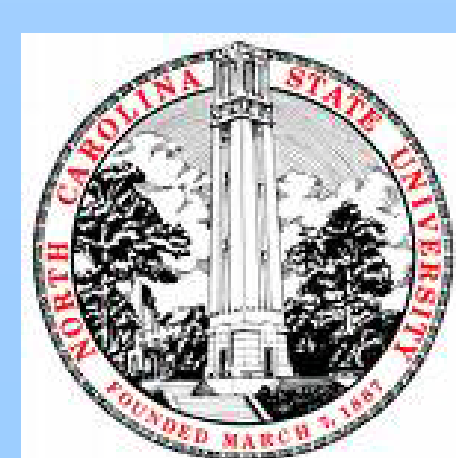


Fig 1. NCSU MIST Test Chamber



Fig 2. NIOSH LRPL Test Chamber

Proposed Approach

- Select a range of PPE ensembles that are certified to at least one of the standards that require a TIL ensemble test
- Utilize human subjects to conduct testing on the selected ensembles
- Test using the same human subjects and ensembles for each of the three ensemble TIL tests
- Determine correlation factors and rank protection factors for each of the ensembles
- Develop recommendations for SDOs to use as a basis for selecting ensemble TIL tests and criteria

Proposed Methods

TIL Method	Challenge	Standards	Laboratory
ILT	Sulfur Hexafluoride (SF ₆)	NFPA 1991	Underwriters Laboratories (RTP, NC)
MIST	Methyl Salicylate (MeS)	ASTM F2588 and NFPA 1951, 1971, 1994	North Carolina State University (Raleigh, NC)
LRPL (modified)	Corn Oil	42 CFR Part 84	NIOSH NPPTL (Pittsburgh, PA)

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Proposed Methods Cont'd

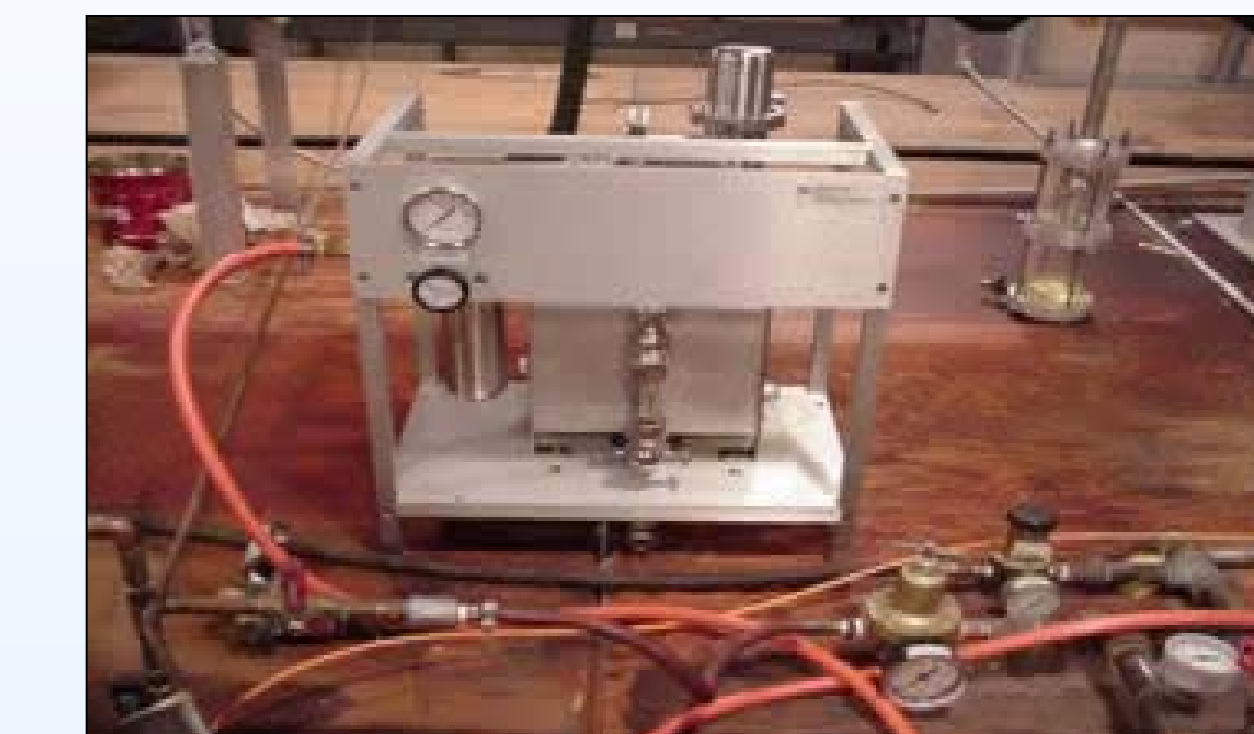


Fig 3. Aerosol Generator for LRPL Test

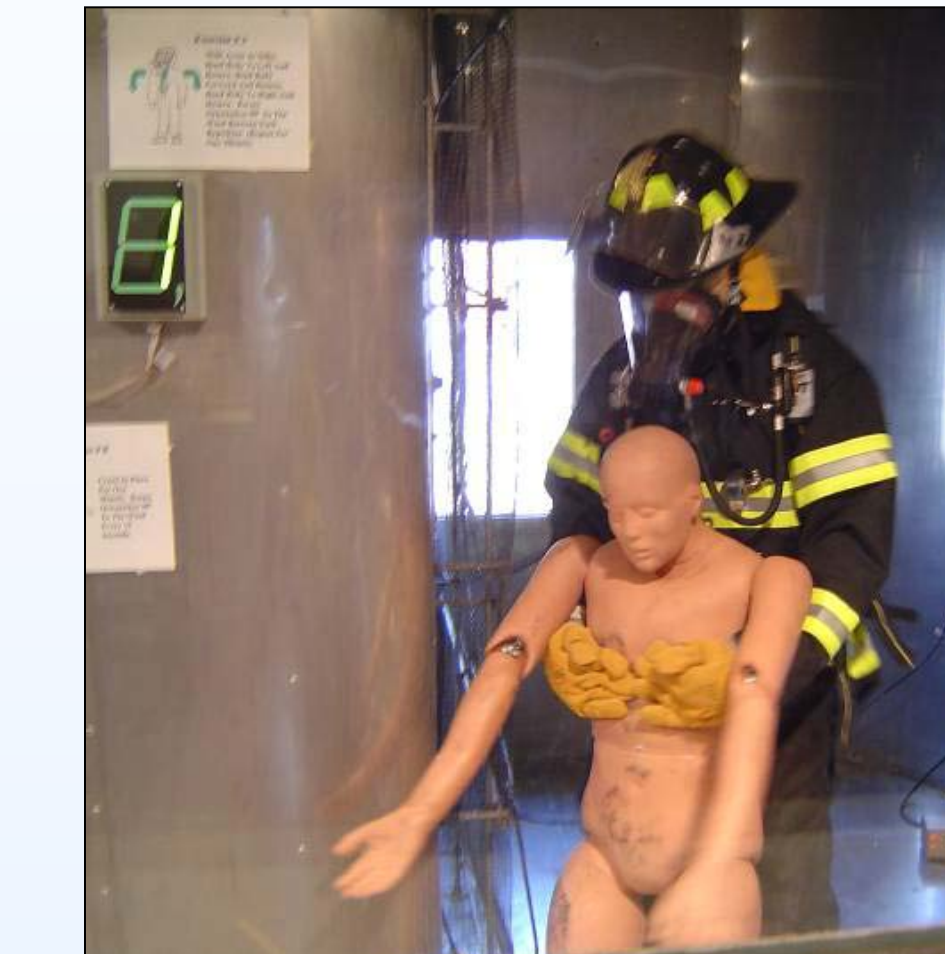


Fig 4. Dummy Drag Activity in the MIST Test

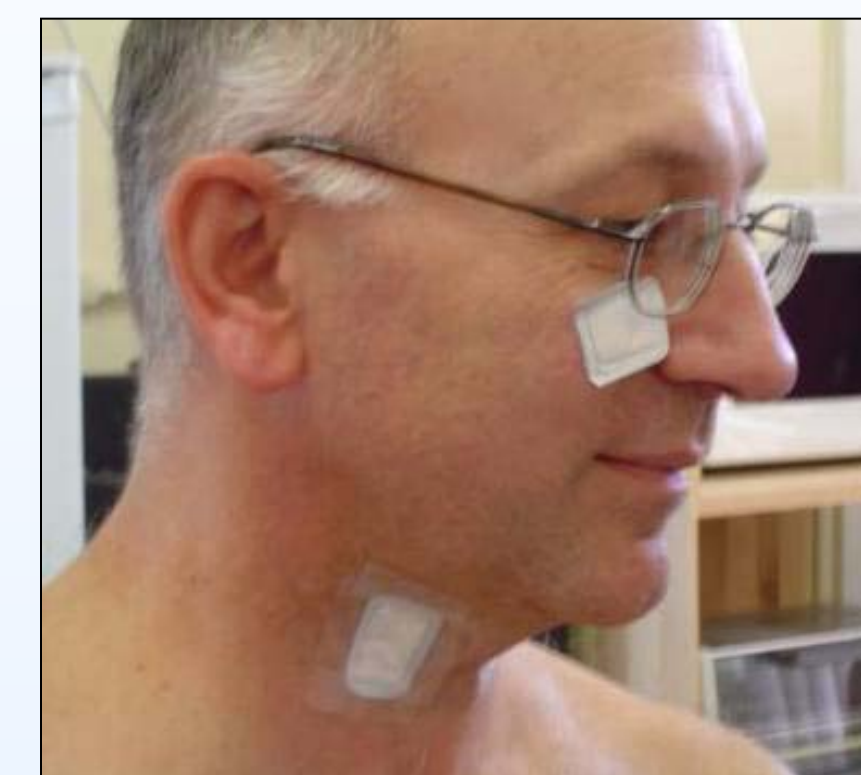


Fig 5. PAD Samplers on Test Subject

- Examine methods of vapor/aerosol generation (Fig 3)
- Identify the differences between exercise protocols and understand the intended physical challenge to the ensemble (Fig 4)
- Evaluate the collection and measurement of the vapor/aerosol challenge (Fig 5)

Project Milestones and Timeline

Activity	Completion
Develop project proposal / test plan	Q2 2010
Complete peer-review and HSRB review	Q4 2010
Conduct human subject testing	Q3 2011
Analyze data and prepare final report	Q4 2011
Finalize recommendations to SDOs	Q2 2012
Project completion / Journal articles	Q4 2012

Expected Project Outputs

- Presentations at PPE Conferences
- Recommendations on test method selection including criteria, applicable hazard area, and protection factor
- Creation of ASTM work items to develop specific methods for the SF₆ and Corn Oil tests.